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High Protein Wheat

With Conservation Farming

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Idaho's wheat often ranks first in agricultural income even in competition with the state's fine production of livestock, dairy products, and the famous Idaho potato. The value of the 1948 crop was almost $56,000,000. With the exception of Idaho's standing timber, no other crop lends more scenic beauty to the state than her fields of wheat—endless green in the spring, waving amber in late summer and fall. It is safe to say that there is no other crop in the state of which farmers are so proud.

High Protein Wheat With Conservation Farming

HUGH C. MCKAY AND W. A. MOSS*

Idaho farmers and millers have been concerned for some time about the low protein content of wheat we are raising in many of our dry-farm sections. The low protein level has already meant some loss to our farmers and will mean more unless we can correct this fault. Our low protein wheat is largely the result of lowered organic matter in our soils brought about by erosion and the type of cropping we have practiced. The native fertility of the bunchgrass land was originally high, so that for many years after farming began, we raised excellent wheat crops and our wheat had a high protein content. Repeated cropping to wheat under the summer fallow system has caused excessive erosion and the depletion of organic matter and nitrogen reserves. As erosion has continued and our organic matter has dwindled, erosion has become progressively more serious and the per-acre yield of wheat and its protein content have been markedly lower.

The "Big-3" of Wheat Protein Content

Three principal factors affect the protein content of our wheat. The nitrogen available, dependent upon the organic matter in our soil, is of first consideration. We are directly concerned with this problem and can do something about it. Weather and variety are the other two factors that influence the protein content of our wheat. Weather affects protein content in that it retards the vegetative development of the wheat plant during a dry season. When this occurs, available nitrogen goes into the grain thereby increasing the protein. During a wet season, the increased crop growth requires more nitrogen which leaves less for the grain. This causes a decrease in protein content. Wheat plants remain green for a longer period of time after heading during a wet season. This gives more time for producing and depositing starch in the wheat kernels.

While wheat varieties differ in protein content, other factors such as disease resistance, yield, and market preference are more important in choosing the best variety to grow.

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* Data taken from rotation plots 1944-48.

What We Can Do About It

We have two methods of increasing wheat yields and protein content—the use of soil conserving legume grass rotations, and the application of supplemental commercial nitrogen fertilizer. Because legumes in mixture with grasses also restore and help to maintain soil organic matter so necessary for erosion control and permanent soil productivity, it is advisable to use legumes to provide the major nitrogen needs. Commercial nitrogen fertilizers may often be used to supplement the nitrogen provided by legumes. But, since they may have little or no effect on maintenance of soil organic matter at desirable levels, relying on them as the sole source of nitrogen is not wise.

Rotations Adapted to a Summer Fallow System

The type of rotation we need will depend upon the farming system, the rainfall received, and upon the seriousness of erosion. The alfalfa-grass and sweetclover-grass rotations we suggest here are well adapted to use on dry farmed wheat lands. The legumes add nitrogen, and the fibrous root systems of the grasses improve soil structure and greatly increase the total amount of organic matter returned to the soil.

Growers can expect the same general increase in wheat yields and protein from the use of sweet clover or alfalfa alone without grass. However, either sweet clover or alfalfa alone does not return so much organic matter in the form of roots and crowns nor is it so efficient in erosion control as legume-grass mixtures.

	7-year sweetclover-grass rotation	9-year alfalfa-grass rotation
1st year	Sweetclover-grass seeding	Alfalfa-grass seeding
2nd year	Sweetclover-grass (green manure)	Alfalfa-grass (hay)
3rd year	Wheat	Alfalfa-grass (hay-fall plow)
4th year	Fallow	Fallow
5th year	Wheat	Wheat
6th year	Fallow	Fallow
7th year	Wheat (Fall Plow Stubble)	Wheat
8th year	.....	Fallow
9th year	.....	Wheat

Either of the above rotations may be modified to fit the conservation needs of different kinds of land on the farm or to meet the feed requirements of farm livestock.

The sweetclover-grass rotation is primarily adapted to non-livestock farms with the second-year sod stands used for green manure. However, the second-year stands may be grazed or used for hay. Rotations with alfalfa-grass are well adapted to livestock farms. They are more effective in controlling erosion and their use is pref-

erable on steeply sloping grain lands. In either rotation the period of wheat and fallow may be shortened to provide greater effectiveness in controlling erosion or building up low fertility soils.

Selecting the right grasses for these rotations is important. Experiments show best results from the use of mountain bromegrass or slender wheatgrass with yellow-blossom sweet clover. For the alfalfa grass mixtures, smooth brome and big bluegrass can be used in the higher rainfall areas and crested wheatgrass in the lower rainfall areas. Ladak alfalfa is best on dry land.

Methods of Establishment

The best method for establishing legume and grass stands is to seed in the early spring without a companion crop. This is especially true of alfalfa-grass mixtures which occupy the land for several years and where a failure to obtain a good stand would be costly. Let fall plowed ground remain rough over winter. In the spring, work the ground down with the disk harrow and firm it with a packer before seeding. It is important to seed early in the spring so the legumes and grasses may make as much growth as possible before hot weather. Sometime in the summer, it may be necessary to clip the field for weed control. When this becomes necessary, clip as high as possible so that you remove only a minimum of legume and grass growth.

In areas with more than 13 inches of annual rainfall, many farmers seed their legumes and grasses with a companion crop of spring grain. Seeding the legumes and grasses in alternate rows with grain reduces competition. To seed in alternate rows, plug every other hole in the grain box and the alternate holes in the grass seed attachment. Take the spring tension off those disks which are planting the legume seeds. This prevents seeding too deeply. Growers sometimes produce good stands of sweet clover by drilling the seed in the spring over winter grain planted the previous fall. Take the tension off the disks if you try this system. This will not injure the wheat and will have some weeding action. If you use a companion crop, seed it at a rate of not more than 25 to 30 pounds per acre. Thick stands cause too much competition.

Methods of Handling the Sweet Clover Grass

Occasionally one of our farmers reports that his first crop of wheat following sweet clover has burned. Such growers have blamed this burning to the increased nitrogen in the soil, but we believe that possibly a lack of moisture was more to blame. Experiments at the Tetonia branch station bear this out under certain conditions as indicated in Table 1.

Table 1. Inches of water remaining in the soil at seeding time of the first crop of wheat following plowing of sweet clover and grass at various heights of growth.

Height of sweet clover and grass when plowed	Inches of water remaining in first 6 ft. of soil at seeding time in the fall.
12 - 14 inches	12.59
20 - 22 inches	10.29
34 - 36 inches	7.13
Normal fallow	13.92

Allowing the sweet clover to make too much growth uses up the subsoil moisture leaving only one winter's moisture then available for the crop. Burning may result under these conditions. We recommend plowing down the sweet clover when it reaches a height of 12 to 22 inches.

If you follow the alfalfa-grass rotation, plow the alfalfa-grass sod the fall of the third year. You will conserve more moisture and get a better fallow by fall plowing instead of spring plowing. On the steeper more seriously eroded areas, leave the alfalfa grass for a longer period.

Effect On Yield

To you as a farmer the most important measures for determining the success or failure of your wheat farming methods are the yields and protein content of the wheat you produce and the conservation of your soil. Table 2 gives the yields of wheat we harvested at the Tetonia Station after plowing down sweet clover at various heights.

Table 2. First year yields of wheat in bushels per acre following plowing down sweet clover and grass at various heights.

Height of plowing down sweet clover or sweet clover and grass	Yields in bushels per acre
12 - 14 inches	38.7 bushels
20 - 22 inches	38.9 bushels
34 - 36 inches	33.6 bushels
Normal fallow	35.0 bushels

We harvest our highest yields and reduce danger of burning when we plow down the sweet clover and grass at heights of 12 to 22 inches. In our tests, yields fell about 5 bushels per acre when we allowed the sweet clover to reach a height of 34 to 36 inches before plowing. The reduced yield was in comparison with the recommended stage of plowing—12 to 22 inches. The yield was even lower than yields from normal fallow.

Since 1944, we have studied both the 7-year sweetclover-grass and the 9-year alfalfa-grass rotations at Tetonia. Increased yields of the first, second, and third wheat crops following sweetclover-grass average 2.7 bushels, and following alfalfa-grass 2.1 bushels over the yields of wheat from the continuous wheat-fallow cropping system. These and other data are given in table 3.

Table 3. Yields of wheat in bushels per acre: A protein content for various legume grass rotations and from application of fertilizer.*

	First crop of wheat following legumes and grass		Second crop of wheat following legumes and grass		Third crop of wheat following legumes and grass	
Rotation	Yield	% Protein	Yield	% Protein	Yield	% Protein
Sw. cl. and grass (plowed down 16-18")	26.1	15.01	30.2	14.65	28.0	15.78
Alfalfa and grass	27.6	18.34	26.6	16.60	28.2	16.38
75 lb. Am. Sul.	25.8	14.95	26.0	14.23	25.0	14.17
Normal fallow	25.3	14.14	25.2	14.01	25.7	13.86

*Data taken from rotation plots 1944-48.

More striking differences occur in protein content. The wheat from the three crops following alfalfa-grass averaged 3.11 percent higher in protein than the wheat grown under continuous wheat-summer fallow, while the sweetclover-grass rotation increased protein content an average of 1.15 percent.

The application of 75 pounds of ammonium sulfate gave no significant increase in yield and only a very slight increase in protein content. It is probable that a greater response from commercial nitrogen would have occurred on soils of a lower fertility level such as occur in parts of the state.

We have two choices for using our sweet clover and grass crops. Either turn them down as a green manure or use them as a surface mulch. In areas where erosion is serious, sweet clover does best as a mulch. Plowing it down with a subsurface plow before the sweet clover reaches a height greater than 16 to 18 inches is probably the best way of doing this. If the sweet clover is taller than that height, turn it down with the moldboard plow as it is difficult to handle if left on the surface of the ground.

ISSUED IN FURTHERANCE OF THE ACTS OF MAY 8 AND JUNE 30, 1914.

COOPERATIVE EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS OF THE STATE OF IDAHO, UNIVERSITY OF IDAHO EXTENSION DIVISION AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING.